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(54) COLOR INK SET FOR INK JET RECORDING AND METHOD FOR CARRYING OUT INK JET RECORDING

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain color ink set for ink jet recording, excellent in reproducibility of color without depending on a material to be recorded, not causing clogging to ultrafine nozzle head and having following property to further sufficient printing frequency and provide a method for carrying out ink jet recording by using the ink set.

SOLUTION: This color ink set for ink jet recording has Magenta ink, cyan ink and yellow ink. Each ink comprises at least water, a coloring material and a water-soluble organic solvent. In the ink, an absorption coefficient A in wavelength  $\lambda_A$  (nm) in which visible absorption spectrum of ink at pH 4-5 exhibits maximum absorption and an absorption coefficient B in wavelength  $\lambda_B$  (nm) in which visible absorption spectrum of ink at pH 7-9 satisfy (a) the formula  $0.85 \leq A/B \leq 1.20$  and (b)  $-10 \leq (\lambda_B - \lambda_A) \leq 10$ .

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CLAIMS

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## [Claim(s)]

[Claim 1] Color ink set for ink jet record which is a color ink set for ink jet record which has Magenta ink, cyanogen ink, and yellow ink, and is characterized by for each of this Magenta ink, cyanogen ink, and yellow ink containing water, color material, and a water-soluble organic solvent at least, and filling the following (a) and (b) to coincidence;

(a) And the absorbance B (abs.) in  $\lambda_B$  (nm) which shows the maximum absorption of the visible extinction spectrum of the ink in the absorbances 7-pH [ A (abs.) and ] 9 in wavelength  $\lambda_A$  (nm) the visible extinction spectrum of the ink in pH 4-5 indicates the maximum absorption to be is  $0.85 \leq A/B \leq 1.20$ , it is (b)- $10 \leq (\lambda_B - \lambda_A) \leq 10$ .

[Claim 2] The ink jet record approach which is made to breathe out ink using the color ink set for ink jet record according to claim 1, and records on a record ingredient.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the ink jet record approach using the color ink set for ink jet record which offers the outstanding color reproduction nature, and this ink in more detail about the color ink set for ink jet record, without being dependent on the property of the charge of a recorded material.

[0002]

[Description of the Prior Art] The principle of an ink jet recording method records a liquid or melting dry ink on discharge, paper, cloth, a film, etc. from a nozzle, a slit, or a porosity film. The approach of carrying out the regurgitation of the ink makes ink breathe out using the electrostatic invitation force. Make ink breathe out using the so-called charge control system and the oscillating pressure of a piezo-electric element. Air bubbles are formed according to the so-called drop method (pressure pulse method) on demand and high temperature. By making it grow up, various kinds of methods, such as the so-called heat ink jet method which makes ink breathe out using the pressure to produce, are proposed, and a very high definition image can be obtained with these methods.

[0003] The aqueosity color ink made to dissolve various kinds of water soluble dye in the liquefied medium which consists of water and a water-soluble organic solvent as ink used for this ink jet recording method, the watercolor pigment ink which made the liquefied medium which consists of water and a water-soluble organic solvent distribute various kinds of pigments, the fat dye ink made to dissolve an oil color in an organic solvent are known. Since the main solvent is water, the water color ink which dissolved water soluble dye also in these ink is excellent in safety. Moreover, in order to use a color, a printing image with it is obtained, it excels also in the preservation stability of ink, and the ink for ink jet record is in use. [ the good color enhancement of a color picture and ] [ highly defined ]

[0004] In recent years, the needs to the printing image of the quality near a photograph are increasing using the ink jet printing technique. It is important that the color reproduction nature of the RGB color which is a secondary color obtained by having the color reproduction nature excellent in Magenta ink, cyanogen ink, and yellow ink itself, and printing these ink in piles further when forming a color picture, in order to respond to these needs is excellent. Moreover, if it takes into consideration printing the ink of two or more color-material concentration levels in piles in order to obtain the printing image of the quality near a photograph, it is important to prevent a blot of the color at the time of printing in piles two or more times, generating of color mixture, and drying delay of a printing object.

[0005] Moreover, because of high-resolution-izing of the printing image by the ink jet record approach of a high resolving smallness drop, the nozzle of the head for ink jet record becomes detailed, and prevention of nozzle blinding is important. On the other hand, in connection with an ink jet printing technique being used widely, an ink jet record form also becomes various and a good quality of printed character came to be required in each recorded material, such as the regular paper developed only for ink jets, coat paper, glossy paper and a postcard and the conventional copy paper, acid paper, and a translucency base material still like a transparency sheet.

[0006] However, the color tone of a printing image may change according to the surface state of a recorded material, for example, pH, in this case. In an acid field, as for this, it is guessed in a structural change that the chromophores of a color molecule are a lifting, consequently the thing which coloring change has produced. Moreover, a color which receives different absorption from the selective absorption of the light which nonuniformity is made to a printing object since the gestalt of condensation and a deposit is not uniform unlike the former because a color condenses and deposits rapidly by change of pH, and it is a lump with comparatively bigger still them, and should be received essentially partly, and is different from the color tone of color-material original apart from the above coloring change may be presented. Furthermore, since the white light joins [ exposure light ] a lifting and classification-by-color light in scattered reflection on a color-material front face, clearness may also deteriorate.

[0007] When the above phenomena arise in that of which permeability, such as a transparency sheet, is required especially, it not only shifts from the color tone of color original, but it becomes a problem of the printing section stopping penetrating light.

[0008] JP,9-3380,A is indicating the color ink set for ink jet record which used at least one kind of the C.I. direct blue 86 or the C.I. direct blue 199 for cyanogen ink, and used the C.I. direct yellow 86 and the C.I. direct yellow 132 for yellow ink for the C.I. direct red 227 as a color material, respectively in Magenta ink. Moreover, JP,9-100427,A is indicating the color ink set for ink jet record which used the C.I. direct blue 199 for cyanogen ink, and used the C.I. direct yellow 142 for yellow ink for the C.I. direct red 227 as a color material, respectively in Magenta ink. Furthermore, in Magenta ink, a C.I. acid blue color is used for cyanogen ink, the C.I. acid yellow 23 is used for yellow ink for the C.I. reactive red 180 and the C.I. acid red 52 as a color material, respectively, and JP,5-194889,A is indicating the color ink set for ink jet record using a further specific vehicle.

[0009] It has proposed that an ink set given in these official reports improves color reproduction nature with those ink sets, respectively. However, these color ink sets for ink jet record were not able to obtain the color reproduction nature with which satisfaction goes to various recorded materials. For example, when a front face printed to an acid recorded material, there was a problem that a gap arose from the color tone of color original. Furthermore, when printed using the detailed nozzle head, there was a problem that the regurgitation was unstable or produced nozzle blinding.

[0010]

[Problem(s) to be Solved by the Invention] As mentioned above, it is not based on the charge of a recorded material, but excels in color reproduction nature, and the color ink set for ink jet record with which are satisfied of the various engine performance which does not carry out blinding to a detailed nozzle head, and is required of the color ink set for ink jet record is not obtained.

[0011] Then, the purpose of this invention is offering the ink jet record approach of having used this ink set for the color ink set for ink jet record which is not based on the charge of a recorded material, but is excellent in color reproduction nature, does not carry out blinding to a detailed nozzle head, and has the imitation nature to still more sufficient printing frequency, and the list.

[0012]

[Means for Solving the Problem] The artificer of this invention etc. came to complete following invention <1>- <12>, as a result of repeating examination wholeheartedly.

<1> It is the color ink set for ink jet record which has Magenta ink, cyanogen ink, and yellow ink, and is the color ink set for ink jet record with which each of this Magenta ink, cyanogen ink, and yellow ink contains water, color material, and a water-soluble organic solvent at least, and fills the following (a) and (b) to coincidence.

(a) The absorbances B (abs.) in wavelength  $\lambda_B$  (nm) the visible extinction spectrum of the ink in the absorbances 7-pH [ A (abs.) and ] 9 in wavelength  $\lambda_A$  (nm) the visible extinction spectrum of the ink in pH 4-5 indicates the maximum absorption to be indicates the maximum absorption to be are relation [ of 0.85  $\leq A/B \leq 1.20$  ],, and (b)-10  $\leq (\lambda_B - \lambda_A) \leq 10$ .

[0013] <2> In the ink set of <1>, it is good for each ink to contain further the nitrogen-containing compound which has the carboxylic acid and/or sulfonic-acid structure (these may be the salts) where the range of electric dissociation exponent in 20 degrees C is 6.0-10.0, and the hydroxide (for it to be expressed with MOH and for M to be chosen from Li, Na, or K) of alkali metal.

<3> In the ink set of <2>, it is good to contain at least one sort by which a nitrogen-containing compound is \*\*\*\*\* (ed) from the group which consists of an aminoethane sulfonic-acid, N, and N-bis(2-hydroxyethyl)-2-aminoethanesulfonic acid, acetamide glycine, N-carbamoyl methyl iminodiacetate, N-tris (hydroxymethyl) methyl-3-amino propane sulfonic-acid and N, and N-bis(2-hydroxyethyl) glycine.

<4> In the ink set of <1>- <3>, it is good that color material is anionic water soluble dye.

[0014] <5> In the ink set of <4>, it is good that it is at least one sort as which this anionic water soluble dye is chosen from the following groups, respectively.

I Magenta : The C.I. reactive red 180, the C.I. acid red 289, and C.I. direct red 75;

II cyanogen : The C.I. direct blue 86, the C.I. direct blue 199, and C.I. acid blue 9; it is III yellow to a list. : The C.I. direct yellow 132 and C.I. direct yellow 144.

[0015] <6> In the ink set of <1>- <5>, it is good for the boiling point in ordinary pressure of one [ at least ] water-soluble organic solvent to be 200 degrees C or more, including two or more sorts of water-soluble organic solvents, and for a water-soluble organic solvent to have cyclic structure.

<7> It sets in the ink set of <1>- <6>, and it is good that the total content in each ink of a water-soluble organic

solvent is 3 - 40 % of the weight.

[0016] <8> It sets in the ink set of <1>- <7>, and it is good that the content in each ink of water soluble dye is 0.1 - 10.0 % of the weight.

<9> In the ink set of <1>- <8>, it is good for cyanogen ink and/or Magenta ink to have at least two kinds of color-material concentration levels.

[0017] <10> It is good that it is the ink jet record approach which is made to breathe out ink using the color ink set for ink jet record of <1>- <9>, and records on a record ingredient.

<11> In the record approach of <10>, it is good that the ink discharge quantity per drop 1 drop is 20 or less ngs.

<12> In the record approach of <10>- <11>, a record ingredient is an ink jet record sheet, and the front face of this sheet is JIS. Z It is good that the 75-degree specular gloss specified by 8741 is 40% or more.

[0018]

[Embodiment of the Invention] Hereafter, this invention is explained to a detail. The color ink set for ink jet record of this invention comes to have Magenta ink, cyanogen ink, and yellow ink, and this ink comes to contain water, color material, and a water-soluble organic solvent at least respectively.

[0019] Moreover, the absorbance B (abs.) in wavelength  $\lambda_B$  (nm) the visible extinction spectrum of this ink in the absorbances 7-pH [ A (abs.) and ] 9 in wavelength  $\lambda_A$  (nm) the visible extinction spectrum of the ink in pH 4-5 indicates the maximum absorption to be indicates the maximum absorption to be respectively this ink (a) It is desirable that it is  $0.85 \leq A/B \leq 1.20$ ; and (b)-10  $\leq (\lambda_B - \lambda_A) \leq 10$ . Here, the absorbance in a certain wavelength which shows the maximum absorption changes with each ink. Therefore, the above-mentioned absorbances A and B are the values when measuring each ink, i.e., an actual measurement. Moreover, even if the absorbance in the wavelength which shows the maximum absorption is based on an independent absorption band, it may be based on the compound absorption band with which two or more absorption bands overlapped.

[0020] When A/B was too small, and condensation and a deposit of color material, or a structural change arises in an acid field, for example, it prints to acid paper, it becomes easy to produce the fall of printing image concentration, and change of a color tone. Moreover, when it prints to a transparency sheet, the fall of printing image concentration and change of a color tone will arise, or the permeability of the printing section will fall further. On the other hand, if A/B is too large, a structural change of color material arises in an acid field, and when it prints to acid paper similarly, it will become easy to produce change of a color tone. Moreover, also when it prints to a transparency sheet, change of a color tone will arise.

[0021] Moreover, the difference  $(\lambda_B - \lambda_A)$  of the wavelength which shows each maximum absorption exceeds 10, namely,  $(\lambda_B - \lambda_A)$  if it is smaller than -10 or becomes larger than 10, change of the color tone by pH will be large, for example, a structural change of color material will arise. For this reason, when it prints, for example to acid paper, it becomes easy to produce change of a color tone. Moreover, also when it prints to a transparency sheet, change of a color tone will arise and a different color from the color tone of color-material original will be presented. As for the conditions of the point of the stability of color material, and color reproduction nature to the above (a), it is desirable that it is  $0.900 \leq A/B \leq 1.10$ , as for the conditions of the above (b), it is desirable that it is  $-5 \leq (\lambda_B - \lambda_A) \leq 5$ , and it is more desirable that they are these combination.

[0022] Although a color and a pigment are used to Magenta ink, cyanogen ink, and yellow ink, respectively as a color material used for the color ink set for ink jet record of this invention, the point of color reproduction nature to a color is desirable, and it is more desirable that it is water soluble dye anionic from the point of safety and dissolution stability. As anionic water soluble dye, acid dye, a substantivity color, reactive dye, the food color, etc. can be used.

[0023] Although it will not be limited especially if anionic water soluble dye is a color with which can be satisfied of the above-mentioned conditions, Magenta ink C. At least one sort chosen from the group which consists of the I. reactive red 180, C.I. acid red 289, and C.I. direct red 75 is contained. Cyanogen ink C. At least one sort chosen from the group which consists of the I. direct blue 86, C.I. direct blue 199, and C.I. acid blue 9 is contained. And yellow ink C. It is good to contain at least one sort chosen from the group which consists of I. direct yellow 132 and C.I. direct yellow 144.

[0024] It is desirable at especially the point that the color reproduction nature which was excellent in color reproduction nature about each color, respectively, was excellent in color reproduction nature also in the RGB color (red, Green, blue) which is a secondary color obtain by print these ink in piles, and was excellent also about the black obtain by print further 3 colors in piles, without be influence of quality of paper by use the color ink set for ink jet record of such combination can be obtain. When a recorded material is a transparency sheet, in addition to the outstanding color reproduction nature, the printing image excellent also in the light transmission nature of the printing section is obtained.

[0025] Moreover, Magenta ink is the C.I. direct red 75, and at least one sort chosen from the group which cyanogen ink becomes from the C.I. direct blue 86 and the C.I. direct blue 199 is contained. The printing image obtained with the color ink set for ink jet record containing at least one sort chosen from the group which yellow ink becomes from the C.I. direct yellow 132 and the C.I. direct yellow 144 In order to show the outstanding lightfastness, it is possible to save the quality of a printing image, without failing to continue at a long period of time, and it is an especially desirable combination.

[0026] The color ink set of this invention may have black ink further by arbitration. Although whichever of a color and a pigment may be used for the color material of black ink, its color is desirable and it is still more desirable that it is anionic water soluble dye. As anionic water soluble dye, although acid dye, a substantivity color, reactive dye, the food color, etc. can be used, especially if it is the color with which can be satisfied of the above-mentioned conditions, it will not be limited. In addition, this black ink may be black ink which consists of a compound color in the above-mentioned cyanogen ink, Magenta ink, and yellow ink.

[0027] Although the content of these colors is based also on the color enhancement of a color, it is desirable that it is 0.1 - 10.0% of the weight of the range to the total amount of ink. A color becomes easy to deposit when image concentration is low when there is too little content of a color, and there is too much content of a color. As for the content of the point of the dissolution stability of a color to a color, it is more desirable that it is 0.3 - 8 % of the weight.

[0028] The water used for this invention has distilled water, ion exchange water, pure water, and desirable ultrapure water, and does not have mixing of a multivalent cation, a microorganism, etc., and ultrapure water is especially used preferably in respect of storage stability and blinding. As for the content of water, it is good among 100 % of the weight of ink whole quantity that it is 50 % of the weight - 98 % of the weight preferably 30 % of the weight to 98% of the weight.

[0029] The water-soluble organic solvent used by this invention has that desirable in which the boiling point in ordinary pressure (about 1 atm) is 200 degrees C or more, and, as for at least one sort of water-soluble organic solvents of them, has cyclic structure, including two or more sorts of water-soluble organic solvents. If the boiling point in these ordinary pressure contains the water-soluble organic solvent which is 200 degrees C or more and has cyclic structure, the nozzle-proof blinding nature at the time of using especially a detailed nozzle head will become good. Moreover, since regurgitation stability also improves, the outstanding image quality can be acquired. As a water-soluble organic solvent which the boiling point in ordinary pressure is 200 degrees C or more, and has cyclic structure, although 2-pyrrolidone, a N-methyl-2-pyrrolidone, sulfolane, ethylene carbonate, propylene carbonate, etc. are mentioned, it is not limited to this. The point of the regurgitation stability of the ink for ink jet record to especially sulfolane is desirable.

[0030] It is desirable that the boiling point in ordinary pressure is 200 degrees C or more, and it is at least one sort chosen from the group which consists of polyhydric alcohol, a polyalkylene glycol, and glycol ether as water-soluble organic solvents other than the water-soluble organic solvent which has cyclic structure. If these water solubility organic solvent is contained in the ink for ink jet record, the moistness of ink and the solubility of color material can become good, can control blinding, can maintain the regurgitation stability of the ink for ink jet record, and can prevent condensation and a deposit of color material also to further long-term preservation.

[0031] Also in these, especially glycerol [ from the point of the dissolution stability of color material ], diethylene-glycol, 2, and 2'-thiodiethanol is desirable. Moreover, from the permeability to the paper of the ink for ink jet record, and the soluble point of color material, glycol ether is desirable and diethylene glycol monoethyl ether, the diethylene-glycol monobutyl ether, and especially the triethylene glycol monobutyl ether are desirable.

[0032] Ethylene glycol, diethylene-glycol, triethylene glycol, polyethylene-glycol, propylene glycol, 1,5-pentanediol, glycerol, 2, and 2'-thiodiethanol, triethanolamine, etc. can be suitably used as above-mentioned polyhydric alcohol and a polyalkylene glycol.

[0033] As above-mentioned glycol ether, ethylene glycol monomethyl ether, ethylene glycol monobutyl ether, diethylene glycol monoethyl ether, the diethylene-glycol monobutyl ether, the triethylene glycol monobutyl ether, propylene glycol monomethyl ether, etc. can be used suitably.

[0034] Moreover, alkanolamines, such as alcohols, such as ethanol, isopropanol, a butanol, and benzyl alcohol, monoethanolamine, diethanolamine, and triethanolamine, may be added apart from such a solvent. The combination of the balance of the regurgitation stability of the ink for the solubility of color material, blinding prevention, and ink jet record to sulfolane and a glycerol or especially the combination of sulfolane and a diethylene glycol is desirable among the above-mentioned organic solvents.

[0035] As for the total content of a water-soluble organic solvent, in this invention, it is desirable among 100 % of the

weight of ink for ink jet record that it is 3 - 40 % of the weight. If there are too few total contents of a water-soluble organic solvent, the ink for ink jet record will dry, and will become easy to deposit, and it will lifting-come to be easy of the poor regurgitation, such as nozzle blinding. On the other hand, if there are too many total contents, fixable [ to the paper of ink ] will be bad, and the viscosity of ink will become high, and it will lifting-come to be easy of the poor regurgitation. It is more desirable from nozzle blinding prevention and the balance of regurgitation stability that it is 10.0 - 35.0 % of the weight. Furthermore, as for the content of the water-soluble organic solvent which the boiling point in ordinary pressure is 200 degrees C or more, and has cyclic structure, it is desirable among 100 % of the weight of ink for ink jet record that it is 5 - 15 % of the weight.

[0036] The color ink set for ink jet record of this invention may also contain components other than the above. For example, as for the color ink set for ink jet record of this invention, it is desirable to contain the nitrogen-containing compound which has the carboxylic acids and/or sulfonic-acid structures where the range of electric dissociation exponent in 20 degrees C is 6.0-10.0, or such salt structures, and the hydroxide (for it to be expressed with MOH and for M to be chosen from the group which consists of Li, Na, and K) of alkali metal. Since pH change at the time of a liquid ink drop reaching the target on the surface of a recorded material by making these nitrogen-containing compounds and hydroxides of alkali metal contain is eased by buffer action, condensation of a color and change of the color tone by the deposit condition can be controlled.

[0037] The nitrogen-containing compound which contains the alkyl group permuted by the carboxyl group and the alkyl group permuted with the sulfonic group as an above-mentioned nitrogen-containing compound is mentioned. Moreover, in addition to a carboxyl group or a sulfonic group, the compound containing the alkyl group further permuted with the hydroxyl group, the alkyl group permuted by the carbamoyl group is mentioned.

[0038] As an alkyl group permuted by the carboxyl group, for example, a carboxymethyl radical, 1-carboxy ethyl group, 2-carboxy ethyl group, a 1-carboxy-n-propyl group, A 2-carboxy-n-propyl group, 3-carboxy propyl group, a 2-carboxy-I-propyl group, 1-carboxy-n-butyl 4-carboxy butyl, 3-carboxy-I-butyl, a 2-methyl-4-carboxyl group, carboxy-t-butyl, 5-carboxy pentyl radical, etc. are mentioned.

[0039] As an alkyl group permuted with the sulfonic group, the alkyl group which replaced this carboxyl group with the sulfonic group is mentioned in the alkyl group permuted by the above-mentioned carboxyl group.

[0040] These acidic groups may be permuted by the alkyl group with the gestalt of a lithium, sodium, a potassium, or ammonium salt. As a desirable example of these acidic groups, a carboxymethyl radical, 1-carboxy ethyl group, a 1-carboxy-n-propyl group, a sulfo methyl group, 1-sulfoethyl radical, and a 1-sulfo-n-propyl group are mentioned.

[0041] As an alkyl group permuted with the hydroxyl group, for example, a methylol radical, 2-hydroxyethyl radical, A methylol methyl group, a TORIMECHI roll methyl group, a 1-hydroxy-n-propyl group, A 2-hydroxy-n-propyl group, 3-hydroxypropyl radical, a 2-hydroxy-I-propyl group, 1-hydroxy-n-butyl, 4-hydroxy butyl, 3-hydroxy-I-butyl, 2-methyl-4-hydroxyl, hydroxy-t-butyl, a 5-hydroxy pentyl radical, etc. are mentioned.

[0042] As an alkyl group permuted by the carbamoyl group, the alkyl group which replaced this carboxyl group by carbamoyl is mentioned in the alkyl group permuted by the above-mentioned carboxyl group. As the desirable example, a methylol radical, 2-hydroxyethyl radical, a TORIMECHI roll methyl group, a carbamoyl methyl group, etc. are mentioned.

[0043] As a nitrogen-containing compound containing these radicals, for example, an acetamide glycine, An N-2-hydroxyethyl glycine, the N-carbamoyl methyl-beta-alanine, An N-2-hydroxyethyl-N-carbamoyl methyl glycine, N-hydroxymethyl-N-carbamoyl methyl-gamma-aminobutyric acid, N-carboxy methylimino diacetoamide, N-carbamoyl methyl iminodiacetate, ;, such as an N-hydroxypropyl imino dipropionic acid, N, and N-bis(2-hydroxyethyl) glycine, or an aminoethane sulfonic acid, N-2-hydroxyethyl-2-aminoethanesulfonic acid, N-3-hydroxypropyl-2-aminoethanesulfonic acid, N-carbamoyl methyl-2-aminoethanesulfonic acid, N, and N-bis(2-hydroxyethyl)-2-aminoethanesulfonic acid, N-2-hydroxyethyl-N-carbamoyl methylamino ethane sulfonic acid, N-2-hydroxyethyl-N-carbamoyl methyl-2-aminoethanesulfonic acid, N and N-screw-carbamoyl methyl-2-aminoethanesulfonic acid, N-2-hydroxyethyl IMINOJI ethane-sulfonic-acid and N-tris (hydroxymethyl) methyl-3-amino propane sulfonic-acid; or these lithiums, sodium, a potassium, or ammonium salt is mentioned.

[0044] In this invention, an aminoethane sulfonic-acid, N, and N-bis(2-hydroxyethyl)-2-aminoethanesulfonic acid, acetamide glycine, N-carbamoyl methyl iminodiacetate, N-tris (hydroxymethyl) methyl-3-amino propane sulfonic-acid, N, and N-bis(2-hydroxyethyl) glycine is desirable in respect of the solubility to an ink vehicle also in the inside of these nitrogen-containing compounds. Moreover, N and N-bis(2-hydroxyethyl)-2-aminoethanesulfonic acid is more desirable in respect of thermal stability. Moreover, since these do not have the absorption of light of a visible region, they do not affect the color tone of a printing image, and permeability. These nitrogen-containing compounds may be used by the one-sort independent, and may use two or more sorts together.



[0045] A suitable amount is suitably chosen by the stability of coloring to the solubility of the color material itself which uses the content in the color ink set for ink jet record of a nitrogen-containing compound, and pH. In order to demonstrate sufficient color-material dissolution stabilization ability and pH stability and for the nitrogen-containing compound itself to be fully able to carry out dissolution stability, 0.03 - 8 % of the weight is desirable, and it is more desirable that it is 0.05 - 3 % of the weight in respect of balance with pH stability and the dissolution stability of this nitrogen-containing compound itself.

[0046] The hydroxide of the alkali metal used by this invention is chosen from the group which consists of a lithium hydroxide, a sodium hydroxide, and a potassium hydroxide. A lithium hydroxide or a sodium hydroxide is [ among these ] desirable in respect of the water retention at the time of ionizing.

[0047] In this invention, the content in the color ink set for ink jet record of the hydroxide of alkali metal cannot generally be \*\*\*\*\* (ed) depending on the content of said nitrogen-containing compound. However, in order to dissolve each color material under color ink set for ink jet record in stability, it is desirable to keep pH of each ink at 6.0-12.0. Therefore, as for the content of the hydroxide of alkali metal, it is desirable that it is 0.003 % of the weight or more. In order to fully control degradation of corrosion and the dissolution of the ingredient which always touches ink within an ink jet recording device including a head ingredient, exfoliation, etc., 5.0 or less % of the weight is desirable, the hydroxide of alkali metal is 0.003 - 5.0% of the weight of within the limits, and, specifically, it is desirable to add so that pH of the color ink set for ink jet record may be adjusted to the range of 6.0-12.0.

[0048] The ink for ink jet record of this invention may contain other components, and can choose those components suitably according to the purpose without a limit especially. For example, the ink for ink jet record of this invention may contain a surfactant. An interaction can arise between color-material molecules, and a surface active agent can raise the wettability to the paper fiber of color material it not only promotes the permeability to the paper of the ink for ink jet record, but, and can prevent degradation of the image quality by color nonuniformity etc., and degradation of a color tone.

[0049] The surfactant which can be used for this invention is at least one sort chosen from a nonionic surfactant, an anionic surfactant, or an amphoteric surface active agent.

[0050] As a nonionic surface active agent, for example, the polyoxyethylene nonylphenyl ether, Polyoxyethylene octyl phenyl ether, polyoxyethylene dodecyl phenyl ether, etc., Polyoxyethylene alkyl phenyl ether, polyoxyethylene alkyl ether, Polyoxyethylene fatty acid ester, a sorbitan fatty acid ester, a polyoxyethylene-polyoxypropylene block copolymer, The ethyleneoxide addition product of an acetylene glycol, the ethyleneoxide addition product of a glycerol, polyoxyethylene sorbitan fatty acid ester, a fatty-acid ARUKI roll amide, etc. can be used.

[0051] As an anionic surface active agent, alkyl carboxylate, sulfo succinate, its ester salt, etc. of a high-class alkyl sulfonamide can be used for the formalin condensate of alkylbenzene sulfonates, alkylnaphthalenesulfonate, and alkylnaphthalenesulfonate, a higher-fatty-acid salt, the sulfate salt of higher-fatty-acid ester, the sulfonate of higher-fatty-acid ester, the sulfate salt of the higher-alcohol ether and a sulfonate, and a list.

[0052] As an amphoteric surface active agent, a betaine, sulfobetaine, a sulfate betaine, an imidazolidone betaine, etc. can be used.

[0053] In this invention, a pile nonionic surfactant is desirable to a lifting in the ion of color material, the ion of other components, and an interaction also in these surfactants. Polyoxyethylene alkyl ether, polyoxyethylene alkyl phenyl ether, and a polyoxyethylene-polyoxypropylene block copolymer are more desirable in respect of [ especially thermal ] stability and purity.

[0054] In this invention, as for the content in the ink for ink jet record of these surface active agents, it is desirable that it is 0.005 - 5 % of the weight, and it is more desirable that it is 0.01 - 2 % of the weight.

[0055] The ink in the ink set for ink jet record of this invention may contain other components if needed. As other components, they are antifungal agents, such as sodium dehydroacetate and a sodium benzoate, ;P Solubilizing-agent; viscosity controlling agents, such as clathrate compound; ureas, such as germicide; cyclodextrin, such as ROXEL (product made from ICI), and DOWICIL (Dow Chemical Co. make), polish KURODEKISUTOSHIN, and large annular amines, and thiourea; an electric conduction agent etc. can be mentioned.

[0056] The color-material concentration level of each color of the color ink set of this invention is good to set up a suitable level suitably according to the class of color material to be used. Among these, the Magenta and cyanogen ink of a color ink set of this invention are good to set up at least two kinds of color-material concentration levels. When a color-material concentration level sets to 1 the color-material concentration level of the ink which is high concentration most, the color-material concentration level of the ink whose color material is low concentration has the color-material concentration level more desirable than the ink chosen from the range of 2 / 3 - 1/20 from the point of reduction of the granular feeling in the low concentration section of an image. If a level deeper than two thirds is

used, in order that dot density may decrease in the low concentration section of an image, each dot becomes is easy to be checked by looking relatively, and it is in the inclination for a granular feeling to keep even an eye. When a level thinner than 1/20 is used and image concentration is needed to some extent, too much overprint is needed, consequently it is in delay of printing speed, delay of the drying time of a printing image, and the inclination that remains in a printing front face as nonuniformity further, without the ability of media, such as paper, absorbing a liquid ink drop. As balance which does not produce reduction of a granular feeling, and the nonuniformity of a printing image, the color-material concentration level chosen from the range of  $1/2 - 1/10$  is more desirable.

[0057] The color ink set for ink jet record of this invention is good to apply to the ink jet record approach which is made to breathe out each ink and records on a record medium. A well-known technique can be used as a recording method of the ink jet record approach. For example, the so-called heat ink jet method which makes ink breathe out using the pressure produced by forming air bubbles and making it grow up according to the so-called drop method (pressure pulse method) on demand and high temperature which make ink breathe out using the so-called charge control system and the oscillating pressure of a piezo-electric element which make ink breathe out using the electrostatic invitation force can be held.

[0058] In case the regurgitation of the ink is carried out, it is desirable to use for the small drop ink jet record approach for high resolutions which has the ink discharge quantity of per drop 1 piece (one drop) in the range of 20 or less ngs. Although it is also possible to use for the ink jet record approach of having a bigger drop than 20ng(s), in order to obtain the image which was more excellent in high resolution, the small drop ink jet record direction for use for the high resolutions which have the ink discharge quantity per one drop in the range of 20 or less ngs is desirable. Thus, the printing image of high quality can be obtained by using the color ink set for ink jet record of this invention, without producing nozzle blinding. In order to obtain the printing image of high quality more, it is desirable that they are 10 or less ngs, and it is more desirable that they are 5 or less ngs.

[0059] For the color ink set for ink jet record of this invention, the front face printed although a recorded material kind is not chosen is JIS. Z Especially the thing to print to the ink jet record sheet whose 75-degree specular gloss specified by 8741 is 40% or more is desirable. By using and printing the color ink set for ink jet record of this invention to this ink jet record sheet, the printing image excellent in color enhancement and especially color reproduction nature can be obtained. This ink jet record sheet is good to have at least one or more layers of coating layers on the front face printed, and good to contain an inorganic system, an organic system pigment or a particle, and/or at least one sort of cationic matter in this coating layer.

[0060] As an inorganic system, an organic system pigment, or a particle, specific surface area is large and what has a low refractive index is good. For example, inorganic systems, such as a synthetic particle silica, a calcium carbonate, a magnesium carbonate, a kaolin, talc, a calcium sulfate, a barium sulfate, titanium oxide, a zinc oxide, zinc carbonate, aluminum silicate, an aluminum hydroxide, an aluminum oxide, a calcium silicate, a magnesium silicate, the Pori aluminum-hydroxide compound, hydrated alumina, colloidal silica, a grain amyloid particle, a modified starch particle, a plastics pigment, a urea-resin pigment, a crystallization cellulose particle, and an amorphous-sized cellulose particle, an organic system pigment, or a particle can be used. The synthetic particle silica from the point of absorption of ink and the color nature of a printing image, a magnesium carbonate, a barium sulfate, an aluminum hydroxide, the Pori aluminum-hydroxide compound, hydrated alumina, a grain amyloid particle, and a modified starch particle are desirable among these pigments and a particle.

[0061] The cationic resin which is a monomer better known than the former which dissociates as cationic matter when it dissolves in water, and presents cationicity, oligomer, or a polymer, or a cationic surfactant can be used. As cationic resin, polyalkylene polyamine, such as a polyethylene amine and polypropylene polyamine, or the derivative of those, the acrylic resin that has the 3rd class amino group and the 4th class ammonium, a JIAKURIRU amine, etc. are mentioned. As a cationic surfactant, the second or the amine salt of the third class, quarternary ammonium salt, etc. can be used for a start.

[0062]

[Example] Hereafter, although an example explains this invention in more detail, this invention is not limited to these examples at all.

(Examples 1-7 and examples 1-6 of a comparison) By the constituent shown in Table 1 and 2, 12 sorts of ink constituent sets of examples 1-7 and the examples 1-6 of a comparison were prepared. In addition, all the numeric values in Table 1 and 2 are weight %. After fully carrying out the mixed dissolution of each constituent Table 1 and given in Table 2, respectively, Table 1 and pH regulator given in Table 2 adjusted pH of ink to about 7.5, pressure filtration was carried out with 0.45-micrometer filter, and the ink constituent was obtained.

[0063]

[Table 1]

表1. インクに用いた組成

		実施例											
		1			2			3			4		
		C	M	Y	C	M	Y	C	M	Y	C	M	Y
色材	C.I.ダイレクトブルー-199	4.0			3.5			3.0			3.5		
	C.I.アシッドブルー-9				0.3			0.5					
	C.I.ダイレクトブルー-307												
	C.I.リアクティブレッド-180					2.0							
	C.I.アシッドレッド-209											2.0	
	C.I.ダイレクトレッド-75		2.5						2.3				
	C.I.ダイレクトレッド-227												
	C.I.ダイレクトイエロー-132			2.0						2.0			2.2
	C.I.ダイレクトイエロー-144						2.1						
	C.I.ダイレクトイエロー-86												
	C.I.ダイレクトイエロー-142												
	C.I.フードブラック2												
	C.I.ダイレクトブラック195												
水溶性 有機 溶媒	2-ピロリトン	8	8	8									
	N-メチル-2-ピロリトン				5	5	5				5	5	5
	スルフォラン							8	8	8			
	ジエチレングリコール	10	10	10									
	2,2'-チオシエタノール				15	15	15						
	グリセリン							10	10	10			
	エチレングリコール										18	18	18
	エチレングリコールモノブチルエーテル	5	5	5									
	ジエチレングリコールモノブチルエーテル				5	5	5				5	5	5
	プロピレングリコールモノブチルエーテル							5	5	5			
界面 活性剤	サーフィノール465(日信化学社製)	0.1	0.1	0.1									
	フルロニックPE4300(BASF社製)				0.2	0.2	0.2						
	ポリオキシエチレンラウリルエーテル (15モルEO付加物)(日本油脂社製)							0.1	0.1	0.1	0.1	0.1	0.1
pH 緩衝剤	N,N-ビス(2-ヒドロキシエチル)-2-アミノ エタンスルホン酸	0.5	0.5	0.5	0.5	0.5	0.5				0.5	0.5	0.5
	N,N-ビス(2-ヒドロキシエチル)グリシン							0.5	0.5	0.5			
	リン酸二水素カリウム												
	水酸化ナトリウム	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
水	イオン交換水	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量

[0064]

[Table 2]

インクに用いた組成(表1の続き)

	5				6				7						
	C	M	Y	K	C	M	Y	K	C-1	C-2	M-1	M-2	Y	K-1	K-2
色材	C.I.イレクトブルー-199	3.2							3.5	1.0					
	C.I.アゾブルー-9	0.3			4.0										
	C.I.イレクトブルー-307														
	C.I.アゾブルー-180		0.5												
	C.I.アゾブルー-289														
	C.I.イレクトブルー-75	1.5			2.2						2.3	0.66			
	C.I.イレクトブルー-227														
	C.I.イレクトブルー-132						2.0						2.2		
	C.I.イレクトブルー-144		2.3												
	C.I.イレクトブルー-86														
	C.I.イレクトブルー-142														
水溶性有機溶媒	C.I.アゾブルー-72							4.0						4.0	1.1
	C.I.イレクトブルー-195														
	2-ヒドロキシ				10	10	10	10							
	N-メチル-2-ピロリドン														
	スルホキシ	10	10	10					8	8	8	8	8	8	8
	ジエチレングリコール								15	15	15	15	15	15	15
	2,2'-チオビスエタノール	12	12	12											
	グリセリン				10	10	10	10							
	エチレングリコール														
	エチレングリコールモノエーテル	5	5	5					5	5	5	5	5	5	5
	ジエチレングリコールモノエーテル														
界面活性剤	アビスチン				5	5	5								
	サ-ファノール-465(日信化学社製)	0.1	0.1	0.1					0.1	0.1	0.1	0.1	0.1	0.1	0.1
	アルコニックPE4300(BASF社製)				0.2	0.2	0.2	0.2							
	ポリオキシエチレンテトラエーテル														
pH緩衝剤	(15モルEO付加物)(日本油脂社製)														
	NN-ビス(2-ヒドロキシエチル)-2-アミノエタンスルホン酸								0.5	0.5	0.5	0.5	0.5	0.5	0.5
	NN-ビス(2-ヒドロキシエチル)グリシン	0.5	0.5	0.5											
	リン酸三水素カリウム														
水	水酸化ナトリウム	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	イオン交換水	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量

[0065]  
[Table 3]

表2. インクに用いた組成(比較例)

		比較例											
		1			2			3			4		
		C	M	Y	C	M	Y	C	M	Y	C	M	Y
色材	C.I.ダイレクトブルー199							3.5			3.5		
	C.I.ダイレクトブルー307	3.5			3.5								
	C.I.リアクティブレッド180				0.2								
	C.I.アシッドレッド289												
	C.I.ダイレクトレッド75												
	C.I.ダイレクトレッド227		2.2		1.8			2			2		
	C.I.ダイレクトイエロー132												
	C.I.ダイレクトイエロー144												
	C.I.ダイレクトイエロー86			2.3					2				2
	C.I.ダイレクトイエロー142					2							
	C.I.フードブラック2												
	C.I.ダイレクトブラック195												
水溶性 有機 溶媒	2-ピロリドン												
	N-メチル-2-ピロリドン												
	スルフォラン	10	10	10									
	ジエチレングリコール				20	20	20						
	2,2'-チオジエタノール							10	10	10	10	10	10
	グリセリン							10	10	10	10	10	10
	エチレングリコール	10	10	10									
	エチレングリコールモノフチルエーテル				5	5	5						
	ジエチレングリコールモノフチルエーテル							5	5	5	5	5	5
界面 活性剤	プロピレングリコールモノフチルエーテル	5	5	5									
	サーフィノール465(日信化学社製)	0.1	0.1	0.1									
	ブルロニックPE4300(BASF社製)				0.2	0.2	0.2						
pH 緩衝剤	ポリオキシエチレンラウリルエーテル (15モルEO付加物)(日本油脂社製)							0.1	0.1	0.1	0.1	0.1	0.1
	N,N-ビス(2-ヒドロキシエチル)-2-アミノ エタンスルホン酸	0.5	0.5	0.5	0.5	0.5	0.5						
	N,N-ビス(2-ヒドロキシエチル)グリシン							0.5	0.5	0.5			
	リン酸二水素カリウム										0.4	0.4	0.4
	水酸化ナトリウム	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
水	イオン交換水	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量

[0066]

[Table 4]

インクに用いた組成(比較例)(表2の続き)

		比較例										
		5				6						
		C	M	Y	K	C	淡C	M	淡M	Y	K	淡K
色材	C.I.ダイレクトブルー-199											
	C.I.ダイレクトブルー-307	3.5				3.5	1.0					
	C.I.リアクティブレッド180											
	C.I.アシッドレッド289											
	C.I.ダイレクトレッド75											
	C.I.ダイレクトレッド227		2.2					2.3	0.66			
	C.I.ダイレクトイエロー-132											
	C.I.ダイレクトイエロー-144											
	C.I.ダイレクトイエロー-86									2.0		
	C.I.ダイレクトイエロー-142			2.2								
	C.I.フードブラック2											
	C.I.ダイレクトブラック195				3.0						4.0	1.1
水溶性 有機 溶媒	2-ピロリドン	5	5	5	5							
	N-メチル-2-ピロリドン					8	8	8	8	8	8	8
	スルフォラン											
	ジエチレングリコール											
	2,2'-チオシエタノール											
	グリセリン					10	10	10	10	10	10	10
	エチレングリコール	15	15	15	15							
	エチレングリコールモノフチルエーテル					5	5	5	5	5	5	5
	ジエチレングリコールモノフチルエーテル											
	プロピレングリコールモノフチルエーテル	5	5	5	5							
界面 活性剤	サーフィノール465(日信化学社製)					0.1	0.1	0.1	0.1	0.1	0.1	0.1
	フロニックPE4300(BASF社製)	0.2	0.2	0.2	0.2							
	ポリオキシエチレンラウリルエーテル (15モルEO付加物)(日本油脂社製)											
pH 緩衝剤	N,N-ビス(2-ヒドロキシエチル)-2-アミノエタンスルホン酸	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	N,N-ビス(2-ヒドロキシエチル)グリシン											
	リン酸二水素カリウム											
	水酸化ナトリウム	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
水	イオン交換水	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量	残量

[0067] (Measurement of a characteristic value)

each ink of the <absorbance> examples 1-7 and the examples 1-6 of a comparison -- respectively -- pure water -- diluting -- further -- standard buffer solution pH 4.01 (Wako Pure Chem make) -- pH of a diluent -- about 4.5 -- moreover, standard buffer solution pH 9.18 (Wako Pure Chem make) adjusted pH of a diluent to about 8.5, and, finally it diluted with pure water 1000 times. The absorbance of the spectral characteristic was measured for these diluents by the quartz cell with a thickness of 10mm using the recording spectrophotometer (UV-2500PC: Shimadzu make). This result is shown in Table 3.

[0068]

[Table 5]

表3. 各インクの可視吸光スペクトルの結果

		pH4.5		pH8.5		A/B	$\lambda_B - \lambda_A$
		吸光度A	$\lambda_A$	吸光度B	$\lambda_B$		
実施例1	C	1.68	610	1.66	615	1.01	5
	M	1.28	520	1.30	520	0.99	0
	Y	1.34	410	1.26	405	1.06	-5
実施例2	C	1.47	610	1.45	615	1.01	5
	M	1.53	539	1.55	539	0.99	0
	Y	1.28	405	1.23	405	1.04	0
実施例3	C	1.26	610	1.24	615	1.01	5
	M	1.18	520	1.19	520	0.99	0
	Y	1.34	410	1.26	405	1.06	-5
実施例4	C	1.47	610	1.45	615	1.01	5
	M	1.76	528	1.79	526	0.98	0
	Y	1.47	410	1.39	405	1.06	5
実施例5	C	1.34	610	1.33	615	1.01	5
	M	1.23	522	1.24	522	0.99	0
	Y	1.40	405	1.35	405	1.04	0
実施例6	C	1.88	610	1.86	615	1.01	5
	M	1.13	520	1.14	520	0.99	0
	Y	1.22	405	1.17	405	1.04	0
	Bk.	0.86	585	0.87	585	0.99	0
実施例7	C-1	1.47	610	1.45	615	1.01	5
	C-2	0.42	610	0.41	615	1.01	5
	M-1	1.18	520	1.19	520	0.99	0
	M-2	0.34	520	0.34	520	0.99	0
	Y	1.47	410	1.39	405	1.06	5
	Bk.-1	0.86	585	0.87	585	0.99	0
	Bk.-2	0.24	585	0.24	585	0.99	0
比較例1	C	0.88	626	1.46	665	0.60	39
	M	0.70	549	0.84	541	0.84	-8
	Y	1.12	360	1.01	395	1.11	35
比較例2	C	0.88	626	1.46	665	0.60	39
	M	0.57	549	0.68	541	0.84	-8
	Y	0.66	335	1.18	405	0.56	70
比較例3	C	1.47	610	1.45	615	1.01	5
	M	0.64	549	0.76	541	0.84	-8
	Y	0.97	360	0.88	395	1.10	35
比較例4	C	1.47	610	1.45	615	1.01	5
	M	0.64	549	0.76	541	0.84	-8
	Y	0.97	360	0.88	395	1.10	35
比較例5	C	0.88	626	1.46	665	0.60	39
	M	0.70	549	0.84	541	0.84	-8
	Y	0.73	335	1.30	405	0.56	70
	Bk.	0.90	571	1.43	683	0.63	112
比較例6	C-1	0.88	626	1.46	665	0.60	39
	C-2	0.25	626	0.42	665	0.60	39
	M-1	0.70	549	0.84	541	0.84	-8
	M-2	0.20	549	0.24	541	0.84	-8
	Y	0.97	360	0.88	395	1.10	35
	Bk.-1	1.20	571	1.91	683	0.63	112
	Bk.-2	0.33	571	0.62	683	0.63	112

[0069] The amount of <amount of ink drops> ink drops calculated the discharge quantity per drop by measuring the weight in response to the ink which was made to breathe out the image of 1/4 tone of 662x80 dots 5 times using a head under the environment of 20 degrees C and 50%RH, and was breathed out to the wafer of an ink absorber.

[0070] (Evaluation of the ink engine performance)

About each ink set of the <saturation> examples 1-7 and the examples 1-6 of a comparison The ink jet printer made as an experiment is used, and it is commercial glossy paper A for ink jet printers (75 degree specular gloss: 82%), the Fuji Xerox make -- the same -- the commercial glossy paper B for ink jet printers (75 degree specular gloss: 64%) The Seiko Epson make, FX-L paper (alkaline paper, Fuji Xerox make), And the cyanogen which is the (i) primary color at 4024 papers (acid paper, Xerox Corp. make), Magenta and yellow; -- solid image [ of the RGB color which is

the (ii) secondary color ]; -- the solid image of the black which carried out the overprint of cyanogen (iii), a Magenta, and the yellow to the list was printed, and visual comparison organic-functions evaluation of saturation was performed. A result is shown in Table 4 and 5.

[0071] In addition, the evaluation criterion is as follows.

O : there is almost no dullness of a color solid image.

\*\* : The color solid image wears dullness a little.

x : The dullness of a color solid image is intense.

[0072] Moreover, the evaluation criterion of black (iii) is as follows at the red of the (ii) secondary color, Green and blue, and a list.

(Red)

O : it is a vivid red color.

x : Vermilion color is cutting.

(Green)

O : it is the vivid Green color.

x : It is the somber Green color.

[0073] (Blue)

O : it is a vivid blue color.

x : It is the somber blue color.

(Black)

O : it is pure black.

x : It is the black which wore redness or blueness.

[0074] About each ink set of the <light transmission whenever> examples 1-7 and the examples 1-6 of a comparison, using the ink jet printer made as an experiment, the solid image of the cyanogen which is a primary color, a Magenta, yellow, and the RGB color that is a secondary color was printed to the commercial transparency sheet (Fuji Xerox make), it projected on it with the transparency mold over head projector (Fuji Xerox make), and visual organic-functions evaluation of the color tone of each printing section was performed to it. A result is shown in Table 4 and 5.

[0075] In addition, the evaluation criterion is as follows.

O : it is satisfactory at all to the color tone of a color solid image.

\*\* : A projection image changes [ the color tone of a color solid image ] a little or is a little dark.

x : A projection image changes [ the color tone of a color solid image ] clearly or is dark.

[0076] About each ink set of the <light-fast> examples 1-7 and the examples 1-6 of a comparison The ink jet printer made as an experiment is used, and it is commercial glossy paper A for ink jet printers (75 degree specular gloss: 82%). the Fuji Xerox make -- the same -- the commercial glossy paper B for ink jet printers (75 degree specular gloss: 64%) On the Seiko Epson make, FX-L paper (Fuji Xerox make), and 4024 papers (Xerox Corp. make) (i) The solid image of the black which carried out the overprint of the solid image; (iii) cyanogen of the RGB color which is the cyanogen, the Magenta, and the yellow; (ii) secondary color which are a primary color, a Magenta, and the yellow was printed. After measuring the image concentration with the Macbeth concentration meter, using the light-fast testing machine (XF-180: Shimadzu make), light was irradiated for 100 hours and the color difference before and behind a trial ( $\Delta E^*_{ab} = \{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2\}^{1/2}$ ) was calculated. A result is shown in Table 4 and 5.

[0077] In addition, the evaluation criterion is as follows.

O 25 or less and \*\*:  $\Delta E^*$  have [ :  $\Delta E^*$  ] more greatly [ than 25 ] large or less 40 x:  $\Delta E^*$  40 \*\*s.

[0078] The regurgitation test was performed after time amount disconnection neglect under the environment of 20 degrees C and 50%RH using the ink jet printer of resolution 800dpi which made each ink set of the <blinding-proof nature evaluation> examples 1-7 and the examples 1-6 of a comparison as an experiment at the time of predetermined. A result is shown in Table 6 and 7. In addition, the following criteria estimated.

O The condition in which the regurgitation is possible at :300-second neglect.

\*\* : The condition in which the regurgitation is possible at 180-second neglect.

x : The condition in which the regurgitation is impossible at 180-second neglect.

[0079] Using the ink jet printer which made each ink set of the <image white omission evaluation (imitation nature evaluation to printing frequency)> examples 1-7, and the examples 1-6 of a comparison as an experiment, the solid image was printed on FX-L paper (Fuji Xerox make), and image white omission evaluation by viewing was performed. A result is shown in Table 6 and 7. In addition, the evaluation criterion is as follows.

O : there is no white omission in a solid image, and it is a uniform image.



\*\* : The part from which some is white and it escaped is in a solid image.

x : The part from which it escaped white greatly is in a solid image.

[0080]

[Table 6]

表4. インク性能の評価

		彩度				光透過性	耐光性			
		光沢紙A	光沢紙B	FX-L紙	4024紙		光沢紙A	光沢紙B	FX-L紙	4024紙
実施例1	C	○	○	○	○	○	○	○	○	○
	M	○	○	○	○	○	○	○	○	○
	Y	○	○	○	○	○	○	○	○	○
	R	○	○	○	○	○	○	○	○	○
	G	○	○	○	○	○	○	○	○	○
	B	○	○	○	○	○	○	○	○	○
実施例2	K	○	○	○	○	—	○	○	○	○
	C	○	○	○	○	○	○	○	○	○
	M	○	○	○	○	○	○	△	○	○
	Y	○	○	○	○	○	○	○	○	○
	R	○	○	○	○	○	○	△	○	○
	G	○	○	○	○	○	○	△	○	○
実施例3	B	○	○	○	○	○	○	△	○	○
	K	○	○	○	○	—	○	○	○	○
	C	○	○	○	○	○	○	○	○	○
	M	○	○	○	○	○	○	○	○	○
	Y	○	○	○	○	○	○	○	○	○
	R	○	○	○	○	○	○	○	○	○
実施例4	G	○	○	○	○	○	○	○	○	○
	B	○	○	○	○	○	○	○	○	○
	K	○	○	○	○	—	○	○	○	○
	C	○	○	○	○	○	○	○	○	○
	M	○	○	○	○	○	△	△	○	○
	Y	○	○	○	○	○	△	△	○	○
実施例5	R	○	○	○	○	○	△	△	○	○
	G	○	○	○	○	○	△	△	○	○
	B	○	○	○	○	○	△	△	○	○
	K	○	○	○	○	—	○	○	○	○
	C	○	○	○	○	○	○	○	○	○
	M	○	○	○	○	○	○	○	○	○
実施例6	Y	○	○	○	○	○	○	○	○	○
	Bk	—	—	—	—	—	△	○	○	○
	R	○	○	○	○	○	○	○	○	○
	G	○	○	○	○	○	○	○	○	○
	B	○	○	○	○	○	○	○	○	○
	K	○	○	○	○	—	○	○	○	○
実施例7	C-1	○	○	○	○	○	○	○	○	○
	C-2	○	○	○	○	○	○	○	○	○
	M-1	○	○	○	○	○	○	○	○	○
	M-2	○	○	○	○	○	○	○	○	○
	Y	○	○	○	○	○	○	○	○	○
	Bk-1	—	—	—	—	—	△	○	○	○
	Bk-2	—	—	—	—	—	△	○	○	○
	R	○	○	○	○	○	○	○	○	○
	G	○	○	○	○	○	○	○	○	○
	B	○	○	○	○	—	○	○	○	○
	K	○	○	○	○	—	○	○	○	○

[0081]

[Table 7]

表5. インク性能の評価(比較例)

		彩度				光透過性	耐光性			
		光沢紙A	光沢紙B	FX-L紙	4024紙		光沢紙A	光沢紙B	FX-L紙	4024紙
比較例1	C	x	x	x	x	x	○	○	○	○
	M	○	○	○	x	x	x	x	△	△
	Y	○	○	○	x	△	○	○	○	○
	R	x	x	x	x	△	△	△	△	△
	G	x	x	x	x	x	○	○	○	○
	B	x	x	x	x	x	△	△	△	△
	K	x	x	x	x	—	△	△	△	△
比較例2	C	x	x	x	x	x	○	○	○	○
	M	○	○	○	x	x	x	x	△	△
	Y	○	○	○	x	○	△	△	△	△
	R	○	○	○	x	x	x	x	△	△
	G	x	x	x	x	x	△	△	△	△
	B	x	x	x	x	x	△	△	△	△
	K	○	○	○	x	—	x	x	△	△
比較例3	C	○	○	○	○	○	○	○	○	○
	M	○	○	○	x	x	x	x	△	△
	Y	○	○	○	x	△	○	○	○	○
	R	○	○	○	x	x	△	△	△	△
	G	○	○	○	○	△	○	○	○	○
	B	○	○	○	x	x	x	x	△	△
	K	○	○	○	x	—	△	△	△	△
比較例4	C	○	○	○	△	△	○	○	○	○
	M	○	○	△	x	x	x	x	△	△
	Y	○	○	△	x	x	○	○	○	○
	R	○	○	△	x	x	△	△	△	△
	G	○	○	△	△	x	○	○	○	○
	B	○	○	△	x	x	x	x	△	△
	K	○	○	○	x	—	△	△	△	△
比較例5	C	x	x	x	x	x	○	○	○	○
	M	○	○	○	x	x	x	x	△	△
	Y	○	○	○	x	○	△	△	△	△
	Bk.	—	—	—	—	—	△	△	○	○
	R	○	○	○	x	x	x	x	△	△
	G	x	x	x	x	x	△	△	△	△
	B	x	x	x	x	x	△	△	△	△
比較例6	K	○	○	○	x	—	x	x	△	△
	C-1	x	x	x	x	x	○	○	○	○
	C-2	x	x	x	x	x	○	○	○	○
	M-1	○	○	○	x	x	x	x	△	△
	M-2	○	○	○	x	x	x	x	△	△
	Y	○	○	○	x	△	○	○	○	○
	Bk-1	—	—	—	—	—	△	△	○	○
	Bk-2	—	—	—	—	—	△	△	○	○
	R	x	x	x	x	△	△	△	△	△
	G	x	x	x	x	x	○	○	○	○
	B	x	x	x	x	x	△	△	△	△
	K	x	x	x	x	—	△	△	△	△

[0082]  
[Table 8]

表6. インク性能の評価(その2)

		ドロッ量 (ng)	周波数 応答性	耐目詰 まり性
実施例1	C	7	○	○
	M	8	○	○
	Y	7	○	○
実施例2	C	8	○	○
	M	8	○	○
	Y	8	○	○
実施例3	C	7	○	○
	M	7	○	○
	Y	7	○	○
実施例4	C	9	○	○
	M	8	○	○
	Y	8	○	○
実施例5	C	7	○	○
	M	7	○	○
	Y	6	○	○
実施例6	C	8	○	○
	M	8	○	○
	Y	8	○	○
	Bk.	8	○	○
実施例7	C-1	8	○	○
	C-2	7	○	○
	M-1	8	○	○
	M-2	7	○	○
	Y	8	○	○
	Bk.-1	8	○	○
	Bk.-2	8	○	○

[0083]

[Table 9]

表7. インク性能の評価(その2)(比較例)

		ドロップ量 (ng)	周波数 応答性	耐目詰 まり性
比較例1	C	7	△	×
	M	9	○	△
	Y	9	○	△
比較例2	C	11	△	×
	M	12	△	△
	Y	12	○	△
比較例3	C	9	△	△
	M	9	△	×
	Y	9	△	×
比較例4	C	9	△	×
	M	9	△	×
	Y	9	△	×
比較例5	C	8	△	×
	M	8	△	△
	Y	8	△	△
	Bk.	8	×	×
比較例6	C-1	8	△	×
	C-2	9	△	△
	M-1	8	○	△
	M-2	9	○	○
	Y	8	○	△
	Bk.-1	9	△	×
	Bk.-2	9	△	△

[0084] From the result shown in Table 3 - 7, it became clear that it excelled in the light transmission nature, the lightfastness, nozzle-proof blinding, and frequency-response nature when printing to the color reproduction nature of the secondary color at the time of the color ink set for ink jet record of an example 1 - an example 7 not being based on quality of paper, but printing in piles as well as each ink and a transparency sheet. it -- receiving -- A/B -- or ( $\lambda_B$ - $\lambda_A$ ) became that in which these properties were inferior by the color ink set for ink jet record of the examples 1-6 of a comparison containing the ink in which relation becomes out of range [ this invention ].

[0085]

[Effect of the Invention] According to this invention, it was not based on quality of paper, but excelled in the light transmission nature when printing as well as each ink to the color reproduction nature of the secondary color at the time of printing in piles, and a transparency sheet, and excelled also in lightfastness, and the ink jet record approach using the color ink set for ink jet record which has high dependability, and this ink was offered, without starting nozzle blinding also to a detailed nozzle head.

[Translation done.]